

**LAWRENCE LIVERMORE NATIONAL LABORATORY**  
**7000 EAST AVENUE, L-198, LIVERMORE, CALIFORNIA, 94550**  
Prepared by LLNL under Contract DE-AC52-07NA27344

**LLNL**

**FOREIGN TRIP REPORT**

**LLNL-MI-773014**

**DATE:** April 19, 2019

**SUBJECT:** Report of Foreign Travel to Paris, France

**TO:** Dr. Angela Chambers, USDOE Nuclear Criticality Safety Program Manager, National Nuclear Security Administration, NA-511

**FROM:** David P. Heinrichs, Nuclear Criticality Safety Division Leader, Lawrence Livermore National Laboratory

**MEETING TITLES:**

- International Criticality Safety Benchmark Evaluation Project (ICSBEP) Meeting
- SINBAD Project Meeting
- International Reactor Physics Experiment Evaluation Project (IRPhE) Meeting
- IRSN-LLNL NCSP Coordination Meeting

**MEETING LOCATIONS:**

- Organization for Economic Cooperation and Development (OECD), Nuclear Energy Agency (NEA), 46, Quai Alphonse Le Gallo, 92100 Boulogne-Billancourt, Paris, France
- Institut de Radioprotection et de Sûreté Nucléaire (IRSN), 31 Avenue de la Division Leclerc, Fontenay-aux-Roses, France

**MEETING DATES:**

October 22-29, 2018

**ATTENDEES ON BEHALF OF NCSP:**

David Ames, Teresa Cutler, Doug Bowen, David Heinrichs, Greg Keefer, B. J. Marshall, Geordie McKenzie, Tony Nelson, Jerome Verbeke, Sean Walston, Mike Zerkle

## ATTENDEES UNDER OTHER AUSPICES:

Attendee	Affiliation	Participation
Julian Atfield	Canadian Nuclear Laboratory	IRPhE
John Bess	INL	ICSBEP, IRPhE, SINBAD
Irene Canals	SEA (Spain)	SINBAD
Tom Downar	University of Michigan	IRPhE
Isabelle Duhamel	IRSN	ICSBEP, IRSN
Eric Dumonteil	IRSN	IRSN
Stéphane Evo	IRSN	ICSBEP, IRSN
Benoit Forget	MIT	IRPhE
Max Fratoni	UC-Berkeley	IRPhE
M. Fukushima	Japan Atomic Energy Agency	IRPhE
Satoshi Gunji	Japan Atomic Energy Agency	IRPhE
Ian Hill	OECD NEA	ICSBEP, IRPhE, SINBAD
Evgeny Ivanov	IRSN	IRPhE
Tatiana Ivanova	IRSN	ICSBEP, IRPhE, SINBAD
Yosuke Iwamoto	Japan Atomic Energy Agency	ICSBEP, IRPhE, SINBAD
Vlastimil Juricek	Research Center Řež (Czech)	IRPhE
Anatoly Kochetkov	SCK CEN (Belgium)	IRPhE
Nicolas Leclaire	IRSN	ICSBEP, IRPhE
Jing-Gang Liang	MIT	IRPhE
Julie-Fiona Martin	OECD NEA	IRPhE
Boukhmès Méchitoua	CEA DAM	ICSBEP
Dennis Mennerdahl	E. Mennerdahl Systems (Sweden)	ICSBEP, IRPhE, SINBAD
Wilfried Monange	IRSN	ICSBEP
Pedro Ortega	SEA (Spain)	ICSBEP, IRPhE, SINBAD
Evgeny Rozhikhin	IPPE (Russia)	ICSBEP, IRPhE, SINBAD
Adimir dos Santos	IPEN (Brazil)	ICSBEP, IRPhE, SINBAD
Lori Scott	INL and OECD NEA	ICSBEP, IRPhE, SINBAD
Volkan Seker	University of Michigan	IRPhE
Dan Shen	UC-Berkeley	IRPhE
Luka Snoj	Jožef Stefan Institute (Slovenia)	ICSBEP, IRPhE, SINBAD
Nicolas Thompson	IRSN	IRPhE
Haining Zhou	University of Michigan	IRPhE

## MEETING BENEFITS TO NCSP:

### ICSBEP

The USDOE Office of Defense Programs founded the Criticality Safety Evaluation Project (CSBEP) in 1992 to document and preserve criticality safety benchmark experiments. In 1994, the CSBEP welcomed international participants from France, Hungary, Japan, Russia and the United Kingdom; and in 1995, the DOE allowed the CSBEP to become an official activity of the OECD NEA to further enhance international participation and changed the name to the ICSBEP. As described in the USDOE NCSP Mission and Vision and Five-Year Execution Plan, the ICSBEP remains an important element of information preservation and dissemination.

## **SINBAD**

The Shielding Integral Benchmark Archive Database (SINBAD) started in the 1990s as a collaboration between the OECD NEA Data Bank and Radiation Safety Information Computational Center (RSICC) at ORNL. At present, SINBAD is a large compendium of ‘shielding’ integral experiments, which historically was devoted to the collection and preservation of the experimental information with little emphasis on evaluation. A recent and ongoing effort championed by Ivan Kodeli<sup>1</sup>, Jožef Stefan Institute, Slovenia, is to review selected contents for the completeness of the experimental information, evaluate the experimental sources of uncertainty, and prepare improved and more modern computer code models. This effort is benefitting the NCSP by providing evaluated shielding benchmark data with uncertainty estimates. A subset of these shielding integral experiment benchmarks benefit NCSP either directly for shielding validation purposes used in the calculation of criticality accident doses, nuclear accident dosimetry, or criticality accident alarm response; or indirectly in validating nuclear data at energies applicable to fission systems. Other contents of the compendium, such as high energy accelerator shielding experiments, are not applicable to NCSP due to their higher energies or other particles.

## **IRPhE**

The International Reactor Physics Experiment Evaluation (IRPhE) Project is a follow-on to the ICSBEP focused on the totality of experimental reactor physics data including, but not limited to, critical data. A subset of the critical data benefits NCSP. However, due to the physical complexity of real reactor systems, uncertainties in this critical data is often much too large (e.g.,  $> 1\% \Delta k$ ) to benefit NCSP users or inform nuclear data evaluation.

## **IRSN**

IRSN is an NCSP partner organization and LLNL meets sporadically with IRSN to discuss ongoing and future joint work.

## **MEETING PURPOSE:**

### **ICSBEP**

The meeting commenced with the Head of the Division of Nuclear Science, Dr. Tatiana Ivanova, expressing her appreciation and thanks to the DOE NCSP Manager, Dr. Angela Chambers, for having hosted the previous ICSBEP and IRPhE meetings at George Washington University in Washington, DC.

As shown in the attached agenda, three new NCSP evaluations and one foreign evaluation were reviewed by members of the ICSBEP Technical Review Group (TRG) constituted from the meeting attendees listed above. All four evaluations were “approved” for publication in the next (2018) edition of the International Handbook of Evaluated Criticality Safety Benchmark Experiments. Note that approval is predicated upon resolution of review comments, which will be completed over several months following the meeting. Publication in the Handbook completes NCSP CED-4b milestones as defined in the NCSP Critical & Subcritical Experiment Design Team (CEDT) Process Manual and specified in the NCSP Five-Year Execution Plan tasks for LANL, LLNL and SNL for FY-2018 and 2019.

During this, the 2018 annual meeting, three NCSP evaluations were submitted to the Technical Review Group for pre-publication review and approval:

---

<sup>1</sup> Ivan Kodeli et al., “20 Years of SINBAD (Shielding Integral Benchmark Archive and Database),” Progress in Nuclear Science and Technology, Volume 4 (2014) pp. 308-311; [http://www.aesj.or.jp/publication/pnst004/data/308\\_311.pdf](http://www.aesj.or.jp/publication/pnst004/data/308_311.pdf).

- LEU-COMP-THERM-099, Titanium and Aluminum Sleeve Experiments in Fully-Reflected Water-Moderated U(4.31)O<sub>2</sub> Fuel Rod Lattices with 2.8 cm Pitch, David Ames and Gary Harms, Sandia National Laboratories
- FUND-NCERC-PU-HE3-MULT-003, Copper and Polyethylene-Reflected Plutonium Metal Sphere Subcritical Measurements, Jesson Hutchinson, Los Alamos National Laboratory
- FUND-LLNL-ALPHAN-U235-MULT-001, Subcritical Measurements of Water-Moderated Highly Enriched Uranium Oxide MTR Type Fuel, Tony Nelson, Lawrence Livermore National Laboratory

Unfortunately, Jesson Hutchinson was unable to attend the meeting due to a family emergency requiring his presence in Florida. His evaluation was well represented by a LANL colleague, Teresa Cutler, and LLNL independent reviewers, Greg Keefer and Sean Walston. Note that the methodology utilized in this evaluation is identical to that in previous evaluations FUND-NCERC-PU-HE3-MULT-001 and -002, which also utilized the same detectors and ‘BeRP ball’ but with different reflectors; i.e., nickel and tungsten, respectively.

Note that LEU-COMP-THERM-099 provides additional critical data for thermal systems with titanium and aluminum to that provided previously in 2016 as:

- LEU-COMP-THERM-097, Titanium and/or Aluminum Rod-Replacement Experiments in Fully-Reflected Water-Moderated Square-Pitched U(6.90)O<sub>2</sub> Fuel Rod Lattices with 0.67 Fuel-to-Water Volume Ratio (0.800 cm Pitch).

FUND-LLNL-ALPHAN-U235-MULT-001 provides benchmark subcritical multiplicity data for ISSA<sup>2</sup>, LLNL’s ‘Inherently Safe Subcritical Assembly,’ which consists of simple MTR-type fuel arrays in water. This evaluation is therefore also of interest to subcriticality monitoring of reactor fuel.

As members of the Technical Review Group, the NCSP and other attendees also participated in review of one additional new evaluation:

- LEU-COMP-THERM-103, Critical Loading Configurations of the IPEN/MB-01 Reactor Composed of Fuel Rods and UMo Plates in Its Core Center, Adimir dos Santos, Instituto de Pesquisas Energéticas e Nucleares (IPEN), Brazil

This evaluation is of particular interest to facilities that fabricate or reactors that use UMo fuel for which there is very little relevant critical data in thermal systems.

All four of the new evaluations were formally ‘approved’ for publication pending satisfactory completion of the review comments. As listed in the attached Final Agenda, there was also a major revision to a previously approved IRSN evaluation:

- LEU-COMP-THERM-073, Low-enriched (4.738 wt. % <sup>235</sup>U), low moderated UO<sub>2</sub> rods arrays (1.05 or 1.075-cm square pitch), separated by a variable thickness of water in a tight lattice pitch interaction configuration (third step), Nicolas Leclaire, Institut de Radioprotection et de Sûreté Nucléaire (IRSN), France

In this evaluation the uncertainty analysis and sample calculations were significantly revised.

---

<sup>2</sup> <https://e-reports-ext.llnl.gov/pdf/792300.pdf>

The ICSBEP meeting concluded with:

- A status report by Ian Hill (OECD NEA) on the Database for ICSBEP (DICE) & Correlations
- A general discussion on ISBN numbers for the ICSBEP and other Handbooks
- A general discussion on the ICSBEP Reviewer Guide
- A general discussion on the status of the issues resulting in the significant delay in distributing the previous (2017) edition of the ICSBEP Handbook
- A general discussion on evaluations planned for publication in 2019
- A general discussion on the timing of the next ICSBEP TRG meetings and whether to convene in association with IRPhE, SINBAD, ICNC or other meetings
- Adjournment

## **SINBAD**

As shown in the attached agenda, the SINBAD meeting began with a brief overview of the project's history, previous quality reviews, efforts to develop an evaluation guide, and various administrative matters. Two foreign evaluations were presented at this meeting:

- FNG HCLL Experiment, Irradiation with DT fusion-neutrons of a block of eutectic PbLi bricks, Eurofer plates, polyethylene plates and block including sets of activation foils, Irene Canals, SEA, Spain
- HIMAC Accelerator with Multiple Ions, Energies & Targets, Production of secondary neutrons in the interaction of He, Ne, Si, Ar, Xe ions of energy 100-800 MeV/nucleon on fully stopping targets of C, Al, Cu and Pb, Shuichi Tsuda, JAEA, Japan

These particular experiments are not useful benchmarks for NCSP users because: (a) the eutectic PbLi bricks have unquantifiable density gradients resulting in unquantifiable uncertainties in the benchmark values; and (b) the HIMAC accelerator experiment involves heavy ions at energies in excess of 100 MeV.

While these two experiments are not of benefit to NCSP, it is important to note that many others in the SINBAD compendium are of particular value including:

- Baikal-1 'skyshine' benchmark experiment
- IPPE  $^{252}\text{Cf}$  and 14-MeV neutron transmission through shells of Bi, V, Fe, Th
- OKTAVIAN 14-MeV NTOF with targets of Ni, Fe, Al, Si, W, Mn
- ORNL 'broomstick' transmission in Fe, O, Ni, Na, SST

The Baikal experiment is an important element of Y-12's shielding validation supporting criticality accident alarm system detector placement calculations. The IPPE, OKTAVIAN and 'broomstick' benchmarks are widely used for nuclear data validation. Hence, NCSP should continue to monitor and support SINBAD with evaluations of benefit to the program.

Note also that at this meeting, as at the previous WPEC meeting, SINBAD participants requested LLNL provide a modern evaluation of the LLNL 'Pulse Spheres' NTOF experiments. LLNL plans to prepare an NCSP proposal to address this request.

## IRPhE

Five new evaluations were presented at the IRPhE meeting as shown in the attached agenda.

- KRITZ-LWR-RESR-004, KRITZ-1 Experiments on Regular H<sub>2</sub>O/U(1.35)O<sub>2</sub> Marviken Fuel Rod Lattices at Temperatures Up to 250 °C, Dennis Mennerdahl, E. Mennerdahl Systems, Sweden

The KRITZ-1 experiments were formerly proprietary information of Studsvik Corp. This evaluation has been in development for at least three years and is only slowly coming together. Mike Zerkle (NNL) is attempting to assist the evaluator due to the interest in critical data at elevated temperatures. At this point, it is not known if this effort will actually be finished or result in an acceptable benchmark due to its complexity.

- RB-FUND-EXP-010, RB Reactor: Core RB16/1975, Milan Pešić, Vinča Institute of Nuclear Sciences, Serbia

This evaluation is similar to previous acceptable benchmark evaluations for this reactor published in ICSBEP as LEU-MET-FAST-001, -002, and -015. RB-FUND-EXP-010 provides an additional high quality benchmark with  $k\text{-eff} = 0.9991 \pm 0.0020$  useful to NCSP users interested in LEU in heavy water.

- BEAVRS-PWR-POWER-001, BEAVRS – A Multi-cycle Full Core Commercial PWR Depletion Benchmark, Benoit Forget, Massachusetts Institute of Technology, USA

BEAVRS is unlikely to result in an ‘acceptable’ benchmark as it does not represent any actual system but is a generic composite with very large uncertainties.

- MSRE-MSR-RESR-001, Molten-Salt Reactor Experiment (MSRE) Zero-Power First Critical Experiment with <sup>235</sup>U, Max Fraton and Dan Shen, University of California, Berkeley, USA

The MSRE evaluation was incomplete having no hot dimensions. The analysis is currently significantly over-predicting criticality with  $k\text{-eff} \sim 1.03$ . The analysis will benefit from a thermal scattering law for F-Li-Be, which is in development by NCSU.

- TREAT-FUND-RESR-002, Transient Reactor Test (TREAT) Facility: M8 Calibration (M8CAL) Core Tests, Volkan Seker and Tom Downar, University of Michigan, USA

This evaluation is not of value to NCSP due to large uncertainties in the benchmark  $k\text{-eff}$  value; namely,  $k\text{-eff} = 1.0006 \pm 0.0167$ .

## IRSN

The agenda for the IRSN-LLNL meeting is attached with some elaboration below.

- Benchmark intercomparison project

LLNL’s focus is on expanding the number of benchmark cases to obtain as close to 100% coverage of the LANL ‘Mosteller’, ORNL ‘VALID’, LANL ‘WHISPER’, IAEA ‘Trkov’, and IRSN MORET benchmark suites as possible.

LLNL is providing detailed COG results at least quarterly to Isabelle Duhamel (IRSN) as reported in NCSP QPRs. These results use the ENDFB7R1, ENDFB8R0, and JEFF3.3 nuclear data libraries. The abstract *Expanded COG Criticality Validation Suite* containing LLNL results with US libraries has been accepted for M&C 2019. The full paper is in development.

IRSN's focus is on expanding their number of benchmark cases and collating their results together with COG, MCNP and SCALE results from LLNL, LANL (and LLNL), and ORNL, respectively. IRSN preliminary results have already identified errors due to modeling and errors attributable to nuclear data confirming the value of this project.

Isabelle will discuss with all project participants at the Analytical Methods Working Group and provide a report of accomplishments at the NCSP TPR in March 2019 at Pantex.

- SINBAD

IRSN and LLNL discussed recent SINBAD activities and possible future participation through inclusion of LLNL 'Pulsed Spheres' and other benchmark suites developed at INL (by Soon Kim, now at LLNL) and Y12 (courtesy of Chris Haught).

- 2019 and 2020 Portfolios

The status of all ongoing work was discussed as well as a number of possible future proposals.

#### **ATTACHMENTS:**

- Agenda, International Criticality Safety Benchmark Evaluation Project Technical Review Meeting, 22 October 2018
- Preliminary Agenda, SINBAD Project, Preparatory Technical Review Meeting, 23 October 2018
- Agenda, International Reactor Physics Experiment Evaluation Project Technical Review Meeting, 24-25 October 2018
- Agenda, IRSN-LLNL meeting, October 29, 2018

#### **DISTRIBUTION:**

Approved by Lawrence Livermore National Laboratory for unlimited distribution.

## INTERNATIONAL CRITICALITY SAFETY BENCHMARK EVALUATION PROJECT TECHNICAL REVIEW MEETING

<b>AGENDA</b> <b>22 OCTOBER 2018</b> 46, quai Alphonse Le Gallo, 92100 Boulogne-Billancourt, Paris France Room BB12 <b>Meeting Registration:</b> <a href="http://www.oecd-nea.org/confdb/confdb/conf?id=318">http://www.oecd-nea.org/confdb/confdb/conf?id=318</a> <i>Upon arrival please report to the Reception Desk on the ground floor with a photo ID.</i> <i>A badge will be issued that will allow you to enter the premises at all times during the meeting.</i> <i>Local information about hotels and transport, as well as an area map, can be found on the Web page:</i> <a href="http://www.oecd-nea.org/general/practical/">http://www.oecd-nea.org/general/practical/</a>
---

Monday, 22 October 2018

09:00 – 09:30	SESSION 1:	<b>WELCOME AND INTRODUCTION</b>	
		Welcome and Introduction	Tatiana Ivanova
		Administrative Items: Sign-In, List of Experiments for Next Year	Lori Scott
		Summarize Minor Revisions and Editorial Corrections	John Bess
09:30 – 10:00	SESSION 2:	<b>DISCUSSION OF EVALUATIONS THAT HAVE BEEN SIGNIFICANTLY REVISED</b>	
	LEU-COMP-THERM-073	Low-enriched (4.734 wt % <sup>235</sup> U), low moderated UO <sub>2</sub> rods arrays (1.05 or 1.075-cm square pitch), separated by a variable thickness of water in a tight lattice pitch interaction configuration (third step) (Updated uncertainties and sample calculations)	Nicolas Leflaire
10:00 – 10:15	BREAK		
10:15 – 12:15	SESSION 3:	<b>APPROVAL OF NEW EVALUATIONS</b>	
	LEU-COMP-THERM-099	Titanium and Aluminum Sleeve Experiments in Fully-Reflected Water-Moderated U(4.31)O <sub>2</sub> Fuel Rod Lattices with 2.8 cm Pitch	David Ames Gary Harris
	LEU-COMP-THERM-103	Critical Loading Configurations of the IPEN/MB-01 Reactor Composed of Fuel Rods and UMo Plates in its Core Center	Admir dos Santos
12:15 – 13:15	LUNCH		
13:15 – 14:30	SESSION 4:	<b>APPROVAL OF NEW EVALUATIONS (Continued)</b>	
	FUND-NCERC-PU-HE3-MULT-005	Copper and Polyethylene-Reflected Plutonium Metal Sphere Subcritical Measurements	Jesse Hutchinson
14:30 – 14:45	BREAK		
14:45 – 16:00	SESSION 5:	<b>APPROVAL OF NEW EVALUATIONS (Continued)</b>	
	FUND-LLNL-ALPHAN-U235-MULT-001	Subcritical Measurements of Water-Moderated Highly Enriched Uranium Oxide MTR Type Fuel	Tony Nelson
16:00 – 18:00	SESSION 6:	<b>DISCUSSION</b>	
		GROUP PHOTO	Everyone
		STATUS: ICSBEP Database (DICE) & Correlations	Ian Hill
		STATUS: ISBN Numbers for Benchmark Handbooks	Tatiana Ivanova
		STATUS: Reviewer Guide	John Bess
		STATUS: Handbook Distribution	Tatiana Ivanova
		Evaluations Planned for 2019 Publication	All
		Next ICSBEP/IRPhEP Technical Review Meetings	Tatiana Ivanova
		Adjourn	John Bess



## SINBAD PROJECT. PREPARATORY TECHNICAL REVIEW MEETING

<b>PRELIMINARY AGENDA</b> <b>23 OCTOBER 2018</b> <b>46, quai Alphonse Le Gallo, 92100 Boulogne-Billancourt, Paris France</b> <b>Room BB12</b>
<p><i>Upon arrival please report to the Reception Desk on the ground floor with a photo ID.</i></p> <p><i>A badge will be issued that will allow you to enter the premises at all times during the meeting.</i></p> <p><i>Local information about hotels and transport, as well as an area map, can be found on the Web page:</i></p> <p style="text-align: center;"><a href="http://www.oecd-neq.org/general/practical/">http://www.oecd-neq.org/general/practical/</a></p>

**Tuesday, 23 October 2018**

09:00 – 09:40	<b>SESSION 1</b>	<b>WELCOME AND INTRODUCTION</b>	
		Welcome and Introduction. Link to WPRS and EGRTS Administrative Items	Pedro Ortego Tatiana Ivanova Shuichi Tsuda
9:40 – 10:10	<b>SESSION 2</b>	<b>DOCUMENTATION &amp; GUIDES</b>	
		Content and format guide for alarm and shielding benchmarks, available in ICSBEP	Julie-Fiona Martin
10:10 – 10:30	<b>BREAK</b>		
10:30 – 12:00	<b>SESSION 2</b>	<b>DOCUMENTATION &amp; GUIDES (continued)</b>	
		Proposal of an evaluation guide from EGRTS Discussion on the proposal	Pedro Ortego Dennis Mennerdahl, All
12:00 – 13:00	<b>LUNCH</b>		
13:00 – 13:50	<b>SESSION 3</b>	<b>PRESENTATION OF DRAFT EVALUATIONS</b>	
	HIMAC accelerator with multiple ions, energies and targets	Production of secondary neutrons in the interaction of He, Ne, Si, Ar, Xe ions of energy 100-800 MeV/nucleon on fully stopping targets of C, Al, Cu and Pb	Shuichi Tsuda
13:50 – 14:20	<b>BREAK</b>		
		<b>Group Photo</b>	
14:20 – 16:10	<b>SESSION 3</b>	<b>APPROVAL OF DRAFT EVALUATIONS (continued)</b>	
	FNG HCLL experiment	Irradiation with DT fusion-neutrons of a block of eutectic PbLi bricks, Eurofer plates, polyethylene plates and block including sets of activation foils	Irene Canals
16:10 – 17:00	<b>SESSION 4</b>	<b>PROPOSAL FOR FUTURE EVALUATIONS</b>	
		Shielding Experiment data for accelerator facilities (tentative) Evaluations planned and suggested for future evaluation SINBAD - Next steps Adjourn	Yosuke Iwamoto All Shuichi Tsuda, All Pedro Ortego

# INTERNATIONAL REACTOR PHYSICS EXPERIMENT EVALUATION PROJECT TECHNICAL REVIEW MEETING

## AGENDA

24 – 25 OCTOBER 2018

46, quai Alphonse Le Gallo, 92100 Boulogne-Billancourt, Paris France  
Room BB12

Meeting Registration: <http://www.oecd-nea.org/confdb/confdb/conf?id=318>

Upon arrival please report to the Reception Desk on the ground floor with a photo ID.

A badge will be issued that will allow you to enter the premises at all times during the meeting.

Local information about hotels and transport, as well as an area map, can be found on the Web page:  
<http://www.oecd-nea.org/general/practical/>

Wednesday, 24 October 2018

09:00 – 09:20	SESSION 1:	WELCOME AND INTRODUCTION	
		Welcome and Introduction	Tatiana Ivanova
		Administrative Items: Sign-In, List of Experiment for Next Year	Lori Scott
		Summarize Minor Revisions and Editorial Corrections	John Beas
09:20 – 09:45	SESSION 2:	APPROVAL OF EVALUATIONS THAT HAVE BEEN REVISED TO INCLUDE ADDITIONAL CALCULATION	
	LR(0)-VVER-RESR-003	VVER-1000 Physics Experiments Hexagonal Lattices (1.275 cm Pitch) of Low Enriched U(3.3 wt.% <sup>235</sup> U)/O <sub>2</sub> Fuel Assemblies in Light Water with Graphite and Fluoride Salt Insertions in Central Assembly (Additional calculations supporting bias assessment)	Vlastimil Junek
	CRIT-SPEC		
09:45 – 10:45	SESSION 3:	APPROVAL OF EVALUATIONS THAT HAVE BEEN REVISED TO INCLUDE ADDITIONAL DATA	
	LR(0)-VVER-RESR-002	VVER-1000 Mock-Up Physics Experiments Hexagonal Lattices (1.275 cm Pitch) of Low Enriched U(2.0, 3.0, 3.3 wt.% <sup>235</sup> U)/O <sub>2</sub> Fuel Assemblies in Light Water with H <sub>2</sub> BO <sub>3</sub>	Vlastimil Junek
	CRIT-RRATE-POWDIS		
10:45 – 11:00	BREAK		
11:00 – 12:00	SESSION 4:	APPROVAL OF EVALUATIONS THAT HAVE BEEN REVISED TO INCLUDE ADDITIONAL DATA (Continued)	
	LR(0)-VVER-RESR-004	VVER-1000 Physics Experiments Hexagonal Lattices (1.275 cm Pitch) of Low Enriched U(3.3 wt.% <sup>235</sup> U)/O <sub>2</sub> Fuel Assemblies in Light Water: <sup>15</sup> Azn, <sup>2n</sup> , <sup>23</sup> Na(n,2n), <sup>90</sup> Zr(n,2n), <sup>91</sup> Y(n,2n) Reaction Rates	Vlastimil Junek
	CRIT-RRATE		
12:00 – 13:00	LUNCH		
13:00 – 15:00	SESSION 5:	APPROVAL OF NEW EVALUATIONS	
	KRITZ-LWR-RESR-004	KRITZ-1 Experiments on Regular H <sub>2</sub> O/U(1.35%) Marvikes Fuel Rod Lattices at Temperatures Up to 250 °C	Dennis Messendahl
	CRIT-REAC-COFF		
15:00 – 15:15	BREAK		
15:15 – 18:00	SESSION 6:	APPROVAL OF NEW EVALUATIONS (Continued)	
	RB-FUND-EXP-010	RB Reactor: Core RB16/1975	Milan Petić
	CRIT		
	BEAVRS-PWR-POWER-001	BEAVRS – A Multi-cycle Full Core Commercial PWR Depletion Benchmark	Benoit Forget
	CRIT-REAC-COFF-RRATE		

# INTERNATIONAL REACTOR PHYSICS EXPERIMENT EVALUATION PROJECT TECHNICAL REVIEW MEETING

Thursday, 25 October 2018

09:00 – 10:30	SESSION 7:	APPROVAL OF NEW EVALUATIONS (Continued)	
	MSRE-MSR-RESR-001	Molten-Salt Reactor Experiment (MSRE) Zero-Power First Critical Experiment with $^{235}\text{U}$	Max Fréchet Das Shen
	CRIT		
10:30 – 10:45	BREAK		
10:45 – 12:15	SESSION 8:	APPROVAL OF NEW EVALUATIONS (Continued)	
	TREAT-FUND-RESR-002	Transient Reactor Test (TREAT) Facility: M8 Calibration (MRCAL) Core Tests	Volkan Seker Tom Dowling
	CRIT		
12:15 – 13:15	LUNCH		
13:15 – 14:30	SESSION 9:	DISCUSSION	
		STATUS: MASURCA BERENICE	Gerald Rimpault
		STATUS: Southwest Experimental Fast Oxide Reactor (SEFOR)	Gerald Rimpault
14:30 – 14:45	BREAK		
14:45 – 18:00	SESSION 10:	DISCUSSION (Continued)	
		GROUP PHOTO	Everyone
		STATUS: TVA Watts Bar	Kostadin Ivanov
		STATUS: IRPhEP Database (IDAT)	Ian Hill
		STATUS: IRPhEP Uncertainty Guide	Ian Hill John Bess
		STATUS: Proprietary Benchmarks	Ian Hill
		STATUS: ISBN Numbers for Benchmark Handbooks	Tatiana Ivanova
		STATUS: Reviewer Guide	John Bess
		STATUS: Handbook Distribution	Tatiana Ivanova
		Evaluations Planned for 2019 Publication	All
		Next ICSBEP/IRPhEP Technical Review Meetings	Tatiana Ivanova
		Adjourn	John Bess

## ***IRSN-LLNL meeting***

**Object:** IRSN-LLNL collaboration

**October 29, 2018 - IRSN Fontenay-aux-Roses - Building 25**

9:00-9:30 am	Welcome (Badge, etc.)
9:30-10:00	Benchmark intercomparison (ID)
10:00-10:20	SINBAD (pulsed spheres, shielding benchmarks)
10:20-11:xx	2019 portfolio
11:xx-12:00	2020 Proposals
12h00-14h00	Lunch
14h00-16h30	On-going activities and perspectives on other NCSP activities (TEX experiments, ISSA, Slide rule, benchmark intercomparison...)

- Benchmark intercomparison
- SINBAD (pulsed spheres, shielding benchmarks)
- 2019 portfolio
- 2020 proposals

Let's plan to discuss subcritical multiplicity benchmarks following either the ICSBEP (Monday) or SINBAD (Tuesday) meetings. These meetings should end early and perhaps we can find a congenial meeting place near NEA HQ?

**OAK RIDGE NATIONAL LABORATORY  
MANAGED BY UT-BATTELLE, LLC  
POST OFFICE BOX 2008, OAK RIDGE, TENNESSEE 37831-6170**

**ORNL  
FOREIGN TRIP REPORT  
TA 429991**

**DATE:** October 20, 2018 – October 26, 2018  
**SUBJECT:** Attend ICSBEP, SINBAD, and IRPhEP Technical Review Group meetings  
**TO:** Angela Chambers, Nuclear Criticality Safety Program Manager, National Nuclear Security Administration / NA-511/GTN, Pantex Plant, PO Box 30020, Amarillo, TX 79120-0020

**FROM:** William Jay Marshall

**MEETING:** ICSBEP, IRPhEP, and SINBAD Technical Review Groups  
**TITLE**  
**MEETING:** Nuclear Energy Agency Headquarters; Paris France  
**LOCATION**  
**MEETING:** Monday, October 22, 2018 – Thursday, October 25, 2018  
**DATES**  
**ATTENDEES:** William Marshall, Doug Bowen; others from SNL, LANL, and LLNL  
**ON BEHALF**  
**OF NCSP**  
**MEETING:** ORNL's participation in the ICSBEP, SINBAD, and IRPhEP Technical Review  
**BENEFIT TO** Group (TRG) meetings is identified as a planned foreign trip in the NCSP 2019-2023  
**NCSP** Five Year Plan. Dr. Marshall is an expert on benchmarks and validation, and his participation in the ICSBEP meetings ensures a rigorous review of proposed benchmarks. These high-quality benchmarks can then be used by DOE, NNSA, and commercial facilities throughout the country to perform validations supporting nuclear criticality safety analyses. Similarly, applying the expertise gained through research and applications on criticality safety validation to the shielding (SINBAD) and reactor physics (IRPhEP) benchmark collections will maintain or improve the standards supporting validation in these other areas.

**MEETING** The purpose of the trip is to participate in Technical Review Group (TRG) meetings  
**PURPOSE:** related to proposed benchmarks for criticality safety, shielding, and reactor physics experiments.

**SITES** Nuclear Energy Agency Headquarters, Paris, France  
**VISITED:**

**ABSTRACT:** The ICSBEP, SINBAD, and IRPhEP Technical Review Group (TRG) meetings ensure a rigorous review of proposed benchmarks. These high-quality benchmarks can then be used by DOE, NNSA, and commercial facilities throughout the country to perform validations supporting nuclear criticality safety analyses. Similarly, applying the expertise gained through research and applications on criticality safety validation to the shielding (SINBAD) and reactor physics (IRPhEP) benchmark collections will maintain or improve the standards supporting validation in these other areas.

**Access to the information in this report is limited to those indicated  
on the distribution list and to U.S. Government Agencies and their Contractors.**

## **REPORT OF FOREIGN TRAVEL**

**William Jay Marshall  
Paris, France  
October 20 – 26, 2018**

### **PURPOSE OF TRAVEL**

The purpose of the trip was to attend the Technical Review Group meetings for the International Criticality Safety Benchmark Evaluation Project and the International Reactor Physics Experiment Evaluation Project. The Shielding Integral Benchmark Archive and Database project also had a review meeting, in an effort to establish the path forward for this project.

### **Persons Contacted at NEA Headquarters**

The chair of the ICSBEP and IRPhEP Technical Review Groups is John Bess of INL. NEA participation for these meetings included Ian Hill, Tatiana Ivanova, Julie-Fiona Martin and Shuichi Tsuda. The chair for the SINBAD meeting was Pedro Ortego from SEA in Spain. A range of individuals from different institutions at different countries make up the Technical Review Groups and participated in the associated meetings.

### **Itinerary**

10/20/18 – 10/21/18	Travel from Knoxville, USA to Paris, France
10/22/18	Paris, France (ICSBEP TRG)
10/23/18	Paris, France (SINBAD TRG)
10/24/18 – 10/25/18	Paris, France (IRPhEP TRG)
10/26/18	Travel from Paris, France to Knoxville, TN

## DISTRIBUTION

1. Doug G. Bowen ([bowendg@ornl.gov](mailto:bowendg@ornl.gov))
2. Angela Chambers ([angela.chambers@nnsa.doe.gov](mailto:angela.chambers@nnsa.doe.gov))
3. Lori Scott ([Lorisc0tt@aol.com](mailto:Lorisc0tt@aol.com))